

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* RONALD W. GEDNEY and TAMAR A. POWERS<sup>1</sup>

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Appeal 2006-1454<sup>2</sup>  
Application 09/004,524<sup>3</sup>  
Patent 5,483,421<sup>4</sup>  
Technology Center 2800

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Decided: February 7, 2007

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*Before:* BRADLEY R. GARRIS, FRED E. MCKELVEY, and  
ALLEN R. MACDONALD, *Administrative Patent Judges.*

MACDONALD, *Administrative Patent Judge.*

**DECISION ON APPEAL**

**AFFIRMED**

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<sup>1</sup> Formerly Tamar A. Sholtes.

<sup>2</sup> Notice of Appeal filed June 5, 2000.

<sup>3</sup> Application filed January 8, 1998.

<sup>4</sup> Patent, for which reissue is sought, issued January 9, 1996, based on application 07/848,467, filed March 9, 1992. The real party in interest is International Business Machine Corporation (Br. 1).

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The Examiner has rejected claims 21-25, and 34 of the reissue application on appeal as being unpatentable under 35 U.S.C. § 251 based on recapture.

With respect to the rejection under 35 U.S.C. § 251, the panel affirms the decision of the Examiner.

## **I. INTRODUCTION**

1. Applicants appeal from a final rejection entered January 17, 2002.
2. The reissue application on appeal seeks to reissue U.S. Patent 5,483,421, issued January 9, 1996, based on application 07/848,467, filed March 9, 1992.
3. The reissue application contains claims 1-12, 21-25, and 34.
4. Claims 21-25 and 34 have been rejected under 35 U.S.C. § 251 on the grounds that these claims seek to recapture subject matter surrendered when the patent sought to be reissued was granted.
5. Claims 1-12 have been indicated as being allowable.

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6. Appellants filed:

- (1) an Appeal Brief (the Brief) on August 16, 2000;
- (2) a Reply Brief (the reply) on November 20, 2000; and
- (3) a Supplemental Reply Brief (“the second reply”) on February 18, 2005.

7. The sole issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 21-25, and 34 under 35 U.S.C. § 251 based on recapture.

## **II. FINDINGS OF FACT**

The following findings of fact are believed to be supported by a preponderance of the evidence.

### *A. The Invention*

1. This invention relates generally to the attachment of integrated circuit devices to printed circuit cards, and more particularly to the attachment of integrated circuit (IC) semi-conductor chips to printed circuit cards utilizing a chip carrier which has a coefficient of thermal expansion (TCE) that matches the

thermal coefficient of expansion of the card (U.S. Patent 5,483,421, col. 1, ll. 5-10).

2. Applicants state at column 1, lines 14-20, that:

The packaging of integrated circuit chips for use in computers or similar devices involves the attachment of integrated circuit semiconductor chips to printed circuit boards which printed circuit boards in turn are mounted in various computers or other type devices. The circuit boards have conductors formed thereon which provide the various power, ground and I/O signal lines to the integrated circuit chips.

3. Applicants further state at column 1, lines 21-29, that:

There have been many different prior art proposals for connecting integrated circuit chips to printed circuit boards. The very large difference in thermal coefficient of expansion (TCE) between the silicon device, i.e. the chip, and the printed circuit board generally requires some intermediate device carrier. One such type of interconnection mounts the integrated circuit chip on a ceramic chip carrier or module, which module in turn is mounted on a circuit board.

4. Applicants opine at column 1, line 61 through 2, line 4, that:

While this technique for connection of chips to boards is effective in many instances, it does have several drawbacks and limitations. One very serious drawback is the differential of the expansion of the ceramic chip carrier on one hand and the glass reinforced plastic printed circuit board on the other hand when the board and chip carrier are heated. Because of this differential of expansion, stress is created at the board/module interface, which can lead to material failure. This becomes more critical for larger modules (e.g. high I/O pin count). Another draw back to this type of mounting is the spacing requirements for pin and hole.

5. Applicants state at column 2, lines 11-17, that:

One attempt to overcome these drawbacks is the so-called direct chip attached to the circuit board. This does have many advantages. However, in addition to the thermal mis-match, it does pose certain problems, since the spacing of the interconnect pads on the chip are so very close that they require very fine line patterns on the substrate to which the chip is to be attached.

6. Applicants state at column 2, lines 50-54, that:

Other techniques for attachment of ceramic chip carriers to glass reinforced epoxy circuit boards (FR-4) are shown in IBM Technical Disclosure Bulletin Volume 18, Number 5, Pages 1440-1441 and IBM Technical Disclosure Bulletin Volume 20, Number 8, Pages 3090-3091.

7. Applicants further state at column 2, line 55 through column 3, line 4, that:

In an attempt to overcome the problem of thermal mismatch between the chip carrier and the circuit board it has been proposed to fashion the chip carrier from a material similar to that of the circuit board. Such techniques are described in IBM Technical Disclosure Bulletin Volume 33, Number 2, Pages 15-16 and IBM Technical Disclosure Bulletin Volume 10, Number 12, Pages 1977-1978. However, both of these references require that the connections, at least for the signal I/O lines, be on the same side of the carrier as that to which the chip is mounted. . . . These techniques do solve the problem of thermal mismatch between the chip carrier and the circuit board, but they require peripheral I/O bonding and an additional interposer between the chip and the chip carrier.

8. The invention can be understood by reference to Figures 1 to 4 of the drawings, all of which are reproduced in Appendix 1 of this opinion.

9. Figure 1 is a longitudinal section view, somewhat diagrammatic, showing the connection of a ceramic chip carrier 10 to a glass filled epoxy organic circuit board card 12, conventionally (FR-4) glass-epoxy, by means of solder ball connections, and depicting the stress pattern generated at elevated temperature due to thermal mismatch (col. 3, ll. 47-51).

10. Figure 2 is a graph plotted to depict the relative deformation of a circuit board card and ceramic module under thermal stress showing the average normal strain in each solder ball connection mismatch (col. 3, ll. 52-55).

11. Figure 3 is a graph showing the relative shear displacement between a circuit board and a ceramic module showing strain in the planar direction between the board and module and the average shear strain in each solder ball (col. 3, ll. 56-60).

12. Figure 4 is an exploded perspective view showing the mounting of chips 20 onto a carrier 24 and carrier onto a circuit card (circuit board 38) according to the present invention (col. 3, ll. 61-63).

13. Referring to Figure 1, a somewhat diagrammatic or schematic representation of a ceramic chip carrier 10 mounted on a glass filled epoxy organic circuit card 12 by means of solder ball connections 14 is depicted (col. 4, ll. 2-6).

14. Figure 2 shows the pattern of relative normal displacement between the card and the chip carrier, which describes the deflection of the card and the resulting strain in each solder ball under the same 60° C temperature change.

15. Figure 3 shows the stress in the plane of the module (col. 6, ll. 10-14).

16. From an examination of Figures 1, 2, and 3, it can be seen that when a ceramic carrier is attached to an organic circuit board and the temperature of the structure is changed, a significant amount of stress is introduced into the unit. This stress is carried by or impressed upon the solder ball connection (col. 6, ll. 15-20).

17. Applicants state at column 6, lines 20-31, that:

[I]n order to resist this stress, i.e. to prevent failure of the unit at the solder ball joints 14 or at their connection to the bonding pads on the chip or carrier, the solder balls have to be of sufficient size and strength and the bonds to the pads sufficiently strong or reinforced to withstand the strain without failure. Thus, the solder balls need to act not only as an electrical connector for the chip carrier and circuit board in the relaxed or unstrained condition, they must also act as mechanical structural elements that are "plastic" in nature to prevent the induced differential expansion movement of the card and the chip carrier transmitting sufficient stress to cause failure of the structure.

18. A structure to minimize and, in fact, essentially eliminate any thermal stress due to different coefficients of thermal expansion between the chip carrier and the circuit board is shown in Figure 4 (col. 6, ll. 32-35).

19. According to the present invention, a conventional integrated circuit chip 20 is provided which has an array of input/output (I/O) pads 22 on one side thereof which provides not only input/output signal connections to and from the chip but also power and ground connections (col. 6, ll. 35-39).

20. A chip carrier 24 is provided which has a top surface 26 and a bottom surface 28 (col. 6, ll. 44-45).

21. The top surface 26 of the chip carrier 24 has an array of bonding pads 30 which are arranged in a pattern which pattern corresponds to the pattern or foot print of the I/O pads 22 on the chip 20 (Figure 4; col. 6, ll. 49-52).

22. The bottom surface 28 of the chip carrier 24 has a second set of bonding pads 32 which are connected to the set of bonding pads 30 by metal plated vias 34 (col. 6, ll. 52-55).

23. There can be several layers of material forming the chip carrier with lines 35 formed between each layer and vias 34 interconnecting the various metal layers (col. 6, ll. 55-58).



24. In the present invention, the chip carrier 24 preferably is made of the same material as the circuit board 38 (col. 7, ll. 7-9).

25. If the chip carrier is not fashioned from the same material as the board, it must, in any event, have a similar coefficient of thermal expansion; i.e. the difference in the coefficient of thermal expansion between the carrier and the circuit board should not vary more than about 20% (col. 7, ll. 9-13).

26. The chip carrier and board are made from an organic dielectric material (col. 7, ll. 14-15).

27. In the preferred embodiment, the chip carrier and the board are both made of glass filled epoxy FR-4 material which has a thermal coefficient of expansion of about  $17-20 \times 10^{-6}$  ppm/C (col. 7, ll. 15-18).

28. The chip 20 is mounted to the chip carrier 24 by means of solder balls 36 which interconnect the I/O pads 22 on the chip 20 to the bonding pads 30 on the top surface 26 of the chip carrier 24 (col. 7, ll. 47-50).

29. A circuit board 38 is provided which is preferably formed of the same material as the chip carrier 24 or at least formed of a material that has a similar coefficient of thermal expansion (col. 7, ll. 57-60).

30. The preferred material is an epoxy glass combination usually known in industry as FR-4; but other materials such as polyimides which have similar properties can be used. (col. 7, ll. 60-63).

31. Electrical conducting lines 40 (Figure 4) are provided on the surface of the board with bonding sites 42 formed in an array to correspond to the bonding pads 32 on the bottom surface 28 of the chip carrier 24 (col. 7, ll. 64-67).

32. The bonding pads 32 are then bonded to the bonding sites 42 by means of solder balls 44 (col. 8, ll. 1-2).

33. The solder balls 44 can be any solder material (col. 8, ll. 2-3).

34. An encapsulation material 46, such as a quartz filled epoxy of the type described in U.S. Pat. No. 4,825,284 to Soga et al. can be used to protect and strengthen the solder connections between the device 20 and carrier 24 (col. 8, ll. 12-15).

*B. Prosecution history of the original application*

35. As noted earlier, the patent sought to be reissued was based on Application 07/848,467, filed March 9, 1992 (“original application”).

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36. As filed, the original application contained claims 1-12 which are reproduced in Appendix 2 of this opinion.

37. On February 22, 1993, the Examiner entered a Non-Final Office Action ("Non-Final Action").

38. Claims 1-12 were rejected on various grounds.

39. Claims 5 and 11 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite.

40. Claims 1-12 were rejected under 35 U.S.C. § 103 as being unpatentable over the following prior art:

(1) Soga et al (Soga), U.S. Patent 4,825,284.

(2) Frankeny et al (Frankeny), U.S. Patent 5,065,227.

41. Soga and Frankeny are prior art vis-à-vis applicant under 35 U.S.C. § 102(b) and 35 U.S.C. § 102(e) respectively.

42. The Examiner found that Soga and Frankeny rendered obvious the subject matter of claims 1-12 as filed.

43. In the Non-Final Action, the Examiner found that:

Specifically regarding claims 1 and 7, the applicant's claims 1 and 7 distinguish over Frankeny et al. (5,065,277) by the recitation that the circuit board is formed of an organic material. . . . Most importantly,

[Frankeny] teaches using a solder with a higher melting point for the first connections than the solder for the second connections.

44. The Examiner further found that:

[Soga states] that the carrier (element 9) and the circuit board (element 2) are made of the same material such that . . . the thermal coefficient of expansion of the carrier and the circuit board are approximately equal. Furthermore, [Soga] teaches that the circuit board may be made from an organic material. Thus both [Frankeny and Soga] recognize the problem in the art concerning the structure as claimed and [Soga] goes further to teach that the carrier and the circuit board are made of the same material which can be an organic material.

45. The Examiner held that:

[It] would have been obvious to one of ordinary level of skill in the art to use the solder concept of [Frankeny] on the invention of [Soga] for the purpose of preventing reflow of the first solder connections when the second solder connections are heated.

46. On May 26, 1993, applicants filed an Amendment (“the Amendment”) responding to the Examiner's First Office Action.

47. As shown in Appendix 3 of this opinion, the Amendment:

- (1) cancelled claims 3 and 9;
- (2) added new claims 13 and 14; and
- (3) amended claims 1, 5, 7, and 11.

After entry of the Amendment, the application claims were 1, 2, 4-8, and 10-14.

48. In the Amendment, applicants presented no argument with respect to the patentability of originally filed claims 1-12.

49. In the Amendment at page 8, applicants argued the following as to the amended and new claims:

Turning now to the claims, claim 1 specifically requires that the chip carrier be formed of an epoxy filled glass dielectric material, that the chip carrier have a thermal coefficient of expansion of at least  $17 \times 10^{-6}$  ppm/°C, and requires an encapsulation material encapsulating the first set of solder connections (i.e. the connections between the chip and the chip carrier) and that the circuit board have a coefficient of thermal expansion similar to that of the chip carrier. It is submitted that none of the references cited either alone or in combination teach or suggest such a structure.

50. In the Amendment at page 10, applicants argued with respect to Soga:

[T]here is no indication that the carrier can be made of this material nor is there any indication that the chip carrier can be made of a material with a dielectric constant as high as 17 to  $20 \times 10^{-6}$  ppm/c°. The most that [Soga] can be said to teach is that a multi-layer substrate of an organic can be used to which the ceramic chip carrier is mounted with the carrier having a TCE of  $10-15 \times 10^{-6}$  ppm/°C.

This is not what applicants' invention is. The applicants' invention utilizes a glass filled epoxy substrate having a thermal coefficient of expansion greater than  $17 \times 10^{-6}$  ppm/c° as a chip carrier with a chip mounted thereon by solder interconnections which are encapsulated[.] . . . Soga, et al. teach a carrier of a TCE of  $10-15 \times 10^{-6}$  ppm/°C not a material having a TCE over  $17 \times 10^{-6}$  ppm/°C. Thus, it is believed that Soga, et al. clearly does not teach or suggest the present invention.

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51. On June 29, 1993, the Examiner entered a Final Office Action (“Final Action”).

52. Claims 1, 2, 4-8, and 10-14 were rejected under 35 U.S.C. § 103 as being unpatentable over the following prior art:

- (1) Applicants’ Acknowledged Prior Art (AAPA).
- (2) Ushifusa, U.S. Patent 4,821,142.
- (3) Ogihara, European Patent Application 0337686.

53. Ushifusa and Ogihara are prior art vis-à-vis applicant under 35 U.S.C. § 102(b).

54. The Examiner held that the AAPA, Ushifusa, and Ogihara rendered obvious the subject matter of amended claims 1, 2, 4-8, and 10-12, and new claims 13-14.

55. In the Final Action at page 3, the Examiner held with respect to amended claims 1 and 7 that:

Regarding the circuit board material and expansion coefficient, the Examiner points to page 5 line 15 of the instant application wherein the applicant acknowledges that glass filled epoxy circuit boards are recognized in the art.

56. The Examiner further held that:

[The] only issue in question is whether glass filled epoxy circuit boards possess a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/°C are known and if so, what would lead one . . . [to use] an organic material for the circuit board.

57. At pages 3-4 of the Final Action, the Examiner found that:<sup>5</sup>

[Ogihara at page 2,] in lines 42-44 in the left column, it states that circuit boards [having] a coefficient of thermal expansion as large as  $15 \times 10^{-7}$  to  $25 \times 10^{-7}$  ppm/°C. Furthermore, in the same column in lines 31-41, gives reasons why it is desirable to use an organic material rather than ceramic material.

58. At pages 3-4 of the Final Action, the Examiner noted that:

Regarding the issue of making the chip carrier from the organic material too, the examiner draws the applicant's attention to U.S. Pat. No. 4,821,142 awarded to Ushifusa et al. wherein col. 5 lines 40-47 there is clear suggestion . . . to make the chip carrier and the circuit board from the same material and in col. 6 lines 28-31 it is stated that the chip carrier and the circuit board have substantially the same thermal coefficient of expansion.

59. On September 15, 1993, applicants filed an Amendment After Final ("the Amendment After Final") responding to the Examiner's final action.

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<sup>5</sup> The Examiner's holding contains a typographical error. Ogihara actually teaches  $150 \times 10^{-7}$  to  $250 \times 10^{-7}$  ppm/°C which is  $15 \times 10^{-6}$  to  $25 \times 10^{-6}$  ppm/°C. The original final action shows a correction to the first superscript (changing it from -6 to -7) when in fact it was the second superscript that was in error.

60. Applicants did not amend any claim in the Amendment After Final.

Rather, applicants “requested that the Examiner reconsider his rejection of the claims and allow Claims 1, 2, 4-8 and 10-14.”

61. In the After Final at page 2, applicants argued that the invention claimed distinguishes over the art as follows:

[T]he prior art does not teach making a chip carrier from organic glass-filled epoxy material having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/°C, and the prior art does not teach using a circuit board having a similar co-efficient of thermal expansion as the chip carrier.

62. Applicants further argued at page 2:

[A]pplicants acknowledge that chip carriers and circuit boards have been made of ceramic having similar coefficients of thermal expansion. What applicants do claim is that nobody has disclosed forming a chip carrier of organic glass filled material and a circuit board formed of an organic material having a coefficient of thermal expansion similar to that of the chip carrier and, moreover, that the carrier has a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/°C and joining an organic chip carrier to an organic board with solder connections.

63. Applicants also argued at page 4 of the After Final:

Encapsulating material capsules [sic] the set of solder connections and capsulating [sic] the chip to the chip carrier. Such encapsulating also is not taught by Ushifusa, et al., or by the European reference [to Ogihara].



64. On September 20, 1993, the Examiner entered an Advisory Action indicating that claims 1, 2, 4-8, and 10-14 remained rejected under 35 U.S.C. § 103 over AAPA, Ushifusa, and Ogiwara.

65. On September 30, 1993, applicants filed a Notice of Appeal.

66. On December 2, 1993, applicants filed an Appeal Brief ("the Brief").

67. In the Brief at page 5, applicants argued:

Specifically, it is applicants' position that there is nothing in the cited art that teaches the use of a glass-filled organic chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/°C on which an integrated circuit chip is mounted by means of solder ball technology and wherein the chip carrier is mounted to a circuit board having a similar coefficient of thermal expansion also by means of solder ball technology.

68. Applicants further argued at pages 10-11 of the Brief:

Glass filled epoxy circuit boards are known as admitted by applicants. Rather, the question is: Is there anything in the art that would lead one to select an organic material having this coefficient of thermal expansion as a chip carrier, mount an I/C chip onto this type of carrier with solder ball connections, encapsulate the solder balls connections and then mount this carrier to a circuit board having a coefficient of thermal expansion similar to that of the chip carrier? When viewed in this light, there is no suggestion or motivation found in the references.

69. On June 14, 1995, a panel ("the panel") of the Board of Patent Appeals and Interferences ("the BPAI") entered a decision reversing the decision of the Examiner rejecting claims 1, 2, 4-8, and 10-14 under 35 U.S.C. § 103.

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70. The panel based its decision on an analysis of the Ushifusa patent that showed the patent suggested its chip carrier was limited to less than  $16 \times 10^{-6}$  ppm/°C and the Examiner provided no evidence to counter this suggestion. Thus, the panel concluded “there is no suggestion to make [Ushifusa’s] chip carrier and circuit board out of material having a CTE of at least  $17 \times 10^{-6}$  ppm/°C.”

71. On June 27, 1995, the Examiner entered a Notice of Allowability indicating claims 1, 2, 4-8, and 10-14 were allowable.

72. Consistent with Office practice, the claims were re-numbered in the course of preparing the original application for issue, all as follows:

*Chronological by original claim*

<i>Original claim number</i>	<i>Patent claim as re-numbered</i>
1	1
2	2
3	Cancelled
4	3
5	4
6	5
7	7
8	8
9	Cancelled
10	9
11	10
12	11
13	6
14	12

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*Chronological by patent claim*

<i>Original claim number</i>	<i>Patent claim as re-numbered</i>
1	1
2	2
4	3
5	4
6	5
13	6
7	7
8	8
10	9
11	10
12	11
14	12
3	Cancelled
9	Cancelled

73. U.S. Patent 5,483,421 issued January 9, 1996, based on the original application and contained claims 1-12, all as shown in Appendix 4 of this opinion.

*C. Prosecution of reissue application*

74. Applicants filed reissue application 09/004,524 on January 8, 2000, seeking to reissue U.S. Patent 5,483,421.

75. Applicants presented original patent claims 1-12 along with new reissue application claims 13-34 for consideration.

76. During prosecution reissue claims 13-20 and 26-33 were cancelled.

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77. Ultimately, reissue claims 21-25 and 34 were rejected and claims 1-12 were indicated as allowable.

78. Reissue application claims 21-25 and 34 are before the Board in the appeal.

79. A copy of patent (reissue) claims 1-12 appears in Appendix 4 of this opinion. A copy of reissue application claims 21-25 and 34 appears in Appendix 5 of this opinion.

#### *D. Examiner's Rejection*

80. The Examiner has rejected reissue application claims 21-25 and 34 under 35 U.S.C. § 251 maintaining that the claims seek to "recapture" subject matter surrendered in obtaining allowance of the claims which appear in the patent sought to be reissued.

81. The Examiner based the rejection of claims 21-25 and 34 on the grounds that when faced in the original application with a rejection under 35 U.S.C. § 103 over the Soga and Frankeny prior art patents, applicants made two significant amendments:

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(1) *First*, applicants amended rejected independent claim 1 to add the requirements that the material of the chip carrier is a “glass filled epoxy” and that “said chip carrier having a coefficient of thermal expansion of at least at least  $17 \times 10^{-6}$  ppm/c°”; amended original application claim 1 ultimately became patent claim 1.

(2) *Second*, applicants amended rejected independent claim 7 to add the requirements that the material of the chip carrier is a “glass filled epoxy” and that “said chip carrier having a coefficient of thermal expansion of at least at least  $17 \times 10^{-6}$  ppm/c°”; amended original application claim 7 ultimately became patent claim 7.

82. In addition, the Examiner based the rejection of claims 21-25 and 34 on the grounds that when faced in the original application with a rejection under 35 U.S.C. § 103 over the Soga and Frankeny prior art patents, applicants made two *insignificant* amendments to originally filed claims 1 and 7:

(1) *First*, applicants amended rejected independent claim 1 to add the requirement of “an encapsulation material encapsulating said first set of solder connections”.

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(2) *Second*, applicants amended rejected independent claim 7 to add the requirement of “an encapsulation material encapsulating said first set of solder connections”.

83. The Examiner reasoned as follows (*see* Final Office Action entered March 2, 2000, pages 3-4):

Claims 21-23 and 34 are broader than the original patent claims by the following two limitations: (1) the requirement that the material of the chip carrier is a “glass filled epoxy” has not been included in these claims; and (2) the requirement of “said chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/C°” has been completely left out of these claims.

Claims 24 and 25 are broader than the original patent claims in that the coefficient of thermal expansion of the chip carrier (i.e., “at least  $17 \times 10^{-6}$  ppm/C°”) has been completely left out of these claims.

It is the position of the present Examiner that the Applicants’ Claims 21-25 and 34 are drawn to an invention surrendered during the prosecution in order to obtain allowance of the original patent claims. The Examiner draws attention to the original claims presented in US 5,483,421. Claims 1 and 7, as originally filed in patent Application '467, correspond to Claims 21 and 34, respectively, of the instant Reissue Application except that Reissue Claims 21 and 34 now each include the limitation “an encapsulation material encapsulating said first set of solder connections.” However, this limitation was not considered to be germane to the prior art rejection given in Application '467. This feature was taught by several references cited by Examiner Sparks during prosecution of Application '467.

84. The Examiner further reasoned as follows (*see* Final Office Action entered March 2, 2000, pages 4-5):

Additionally, Applicants repeatedly distinguished the amended (patented) claims of Application '467 over the prior art by arguing that the prior art fails to teach or suggest a chip carrier made of glass filled epoxy FR-4 material which has a thermal coefficient of expansion of at least  $17 \times 10^{-6} / ^\circ\text{C}$ . In fact, the above argument appears to be the patentees' primary basis for distinguishing the broadest claims, independent Claims 1 and 7, from the prior art. Even more compelling is the fact that the Board of Patent Appeals and Interferences ("Board") were persuaded by the patentees' above-mentioned arguments and accordingly reversed the obviousness rejection made by Examiner Sparks based on the above arguments by the patentees.

85. The Examiner then held as follows (*see* Final Office Action entered March 2, 2000, page 6):

Thus, it is clear from the prosecution history that the patentees presented arguments and made changes to the claims with respect to the subject matter of a chip carrier made of glass filled epoxy FR-4 material which has a thermal coefficient of expansion of at least  $17 \times 10^{-6} \text{ ppm}/^\circ\text{C}$  and surrendered claim scope that does not include the limitation of a chip carrier made of glass filled epoxy FR-4 material which has a thermal coefficient of expansion of at least  $17 \times 10^{-6} \text{ ppm}/^\circ\text{C}$ .

Accordingly, the Applicants' exclusion from the Reissue Claims 21-25 and 34 of the "glass filled epoxy FR-4 material" limitation and the "glass filled epoxy FR-4 material which has a thermal coefficient of expansion of at least  $17 \times 10^{-6} \text{ ppm}/^\circ\text{C}$ " limitation makes the Reissue claims broader than the patent claims in this way and is prohibited by 35 USC § 251.

86. The record supports the Examiner's findings with respect to what limitations do not appear in reissue application claims 21-25 and 34 which were present in claims 1 and 7 of the original application, as allowed.

87. An Examiner's Answer ("the Answer") was entered October 19, 2000.

88. The Examiner maintained the rejection under 35 U.S.C. § 251 and set forth an alternative theory of the rejection.

89. The Examiner also based the rejection of claims 21-25 and 34 on the grounds that when faced in the original application with a rejection under 35 U.S.C. § 103 over the Soga and Frankeny prior art patents, applicants made two significant amendments:

(1) *First*, applicants amended rejected independent claim 1 to add the requirements that the material of the chip carrier is a "glass filled epoxy" and that "said chip carrier having a coefficient of thermal expansion of at least at least  $17 \times 10^{-6}$  ppm/c°"; amended original application claim 1 ultimately became patent claim 1.

(2) *Second*, applicants amended rejected independent claim 7 to add the requirements that the material of the chip carrier is a "glass filled epoxy"



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and that “said chip carrier having a coefficient of thermal expansion of at least at least  $17 \times 10^{-6}$  ppm/c°”; amended original application claim 7 ultimately became patent claim 7.

90. The Examiner reasoned as follows (*see Answer*, pages 3-4):

The fact that Claims 21 and 34 are narrower compared to the originally filed Claims 1 and 7 (in the aspect of the above-cited encapsulation material), and broader compared to the amended (patented) Claims 1 and 7 (in the aspect of both the specific chip carrier material, i.e., the glass filled epoxy, and the range of coefficients of thermal expansion of the chip carrier, i.e., at least  $17 \times 10^{-6}$  ppm/°C) has no relevance to the recapture issue as it applies to Claims 21-25 and 34 of the instant reissue Application 09/004,524 now before the Board. This will be made clear in the arguments presented below.

91. The Examiner further reasoned (*see answer*, pages 5 and 9):

(III). The sole issue upon which recapture depends in the instant Reissue Application is the broadening of the patented claims of Application '467 in aspects that were vigorously argued by the Appellants, with agreement by the Board, as patentable over the prior art of record in Application '467 and therefore germane to the prior art rejection, as has already been indicated in the recapture rejection by the present Examiner on pp.4 (bottom two lines) - 6 of the above-cited prior Office Action (Paper No. 7).

...  
(VI). Presently, the Appellants have pending a Reissue Application (No. 09/004,524) wherein reissue Claims 21-25 and 34 are broader than the patented Claims 1-12 of Application '467 in two aspects that are germane to the prior art rejection. Specifically, reissue Claims 21 and 34 are recitations of patented Claims 1 and 7 of

Application '467 minus the limitations of the “glass filled epoxy” carder material and the requirement that the carrier have a CTE of “at least  $17 \times 10^{-6}$  ppm/°C.”

(VII). Clearly, in Claims 21 and 34, the Appellants are attempting to recapture subject matter surrendered by amendment during the prosecution of Application '467. Specifically, the Appellants are trying to recapture “a chip carrier formed of an organic dielectric material” and “a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier” wherein the chip carder is not limited to the glass filled epoxy material of the patented claims, and the coefficient of thermal expansion of the chip carrier is not limited to the specified range of values, i.e., at least  $17 \times 10^{-6}$  ppm/°C, of the patented claims.

92. The Examiner then held (*see* Answer, page 10):

(VIII). The Appellants are thus broadening the patented claims of Application '467 in two aspects germane to the prior art rejection (i.e., the glass filled epoxy and CTE of at least  $17 \times 10^{-6}$  ppm/°C of the chip carrier). These above-cited two aspects were not only vigorously argued by the Appellants as critical to the patentability of the claims over the prior art of record, but the Board further supported and reiterated the Appellants' patentability arguments. Therefore, the Appellants' Claims 21-25 and 34 of the instant Reissue Application 09/004,524, as broadened vis-a-vis the patented claims of Application '467, are clearly in violation of the recapture rule under 35 USC § 251 as set forth in the guidelines for determining recapture by the Clement court (*In re Clement*, (CAFC) 45 USPQ2d 1161).

(IX). Regardless of whether or not the “encapsulation material” limitation in reissue Claims 21-25 and 34 is or is not a patentable feature of the claims, the attempt to recapture the surrendered subject matter as discussed in paragraph (VII), above . . . requires the rejection of Claims 21-25 and 34 under 35 USC § 251.

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93. The record supports the Examiner's findings with respect to what limitations do not appear in reissue application claims 21-25 and 34 which were present in claims 1 and 7 of the original application, as allowed.

### **III. DISCUSSION – REJECTION UNDER 35 U.S.C. § 251**

#### *A. Recapture Principles*

(1)

##### *The statute*

The reissue statute expressly permits a patentee to correct an error thus permitting patentee to obtain reissue claims broader than the originally issued patent claims at any time within two (2) years from the date the original patent issues. More particularly, 35 U.S.C. § 251, ¶¶ 1 and 4, provide in pertinent part:

Whenever any patent is, through error without any deceptive intention, deemed wholly or partly inoperative or invalid, by reason of a defective specification or drawing, or by reason of the patentee claiming more or less than he had a right to claim in the patent, the Director shall, on the surrender of such patent and the payment of the fee required by law, reissue the patent for the invention disclosed in the original patent, and in accordance with a new and amended application, for the unexpired part of the term of the original patent.

No reissued patent shall be granted enlarging the scope of the claims of the original patent unless applied for within two years from the grant of the original patent.

(2)

*Recapture is not an error  
within the meaning of 35 U.S.C. § 251*

What has become known as the “recapture rule,” prevents a patentee from regaining through a reissue patent subject matter that the patentee surrendered in an effort to obtain allowance of claims in the patent sought to be reissued. *In re Clement*, 131 F.3d 1464, 1468, 45 USPQ2d 1161, 1164 (Fed. Cir. 1997).

If a patentee attempts to “recapture” what the patentee previously surrendered in order to obtain allowance of original patent claims, that “deliberate withdrawal or amendment ... cannot be said to involve the inadvertence or mistake contemplated by 35 U.S.C. § 251, and is not an error of the kind which will justify the granting of a reissue patent which includes the [subject] matter withdrawn.” *Mentor Corp. v. Coloplast, Inc.*, 998 F.2d 992, 995, 27 USPQ2d 1521, 1524 (Fed. Cir. 1993), quoting from *Haliczer v. United States*, 356 F.2d 541, 545, 148 USPQ 565, 569 (Ct. Cl. 1966).<sup>6</sup> *See also Hester Industries Inc. v. Stein, Inc.*, 142 F.3d 1472, 1480, 46 USPQ2d 1641, 1647 (Fed. Cir. 1998).

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<sup>6</sup> *Haliczer* is binding precedent. *See South Corp. v. United States*, 690 F.2d 1368, 215 USPQ 657 (Fed. Cir. 1982) (in banc) (decisions of the former U.S. Court of Customs and Patent Appeals and former U.S. Court of Claims decisions are binding precedent).

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(3)  
*In re Clement*

The Federal Circuit's opinion in *Clement* discusses a three-step test for analyzing recapture.

*Step 1* involves a determination of whether and in what aspect any claims sought to be reissued are broader than the patent claims. The Federal Circuit reasoned that a reissue application claim deleting a limitation or element from a patent claim is broader as to that limitation's or element's aspect. 131 F.3d at 1468, 45 USPQ2d at 1164.

*Step 2* involves a determination of whether the broader aspects of the reissue application claims relate to surrendered subject matter. 131 F.3d at 1468-69, 45 USPQ2d at 1164. In this respect, review of arguments and/or amendments during the prosecution history of the application, which matured into the patent sought to be reissued, is appropriate. In reviewing the prosecution history, the Federal Circuit observed that "[d]eliberately canceling or amending a claim in an effort to overcome a [prior art] reference strongly suggests that the applicant admits that the scope of the claim before cancellation or amendment is unpatentable. 131 F.3d at 1469, 45 USPQ2d at 1164.

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*Step 3* is applied when the broadening relates to surrendered subject matter and involves a determination whether the surrendered subject matter has crept into the reissue application claim. *Id.* The following principles were articulated in *Clement*, 131 F.3d at 1470, 45 USPQ2d at 1165:

*Substep (1)*: if the reissue claim is as broad as or broader than the canceled or amended claim in all aspects, the recapture rule bars the claim;

*Substep (2)*: if it is narrower in all aspects, the recapture rules does not apply, but other rejections are possible;

*Substep (3)*: if the reissue claim is broader in some aspects, but narrower in others, then:

(a) if the reissue claim is as broad as or broader in an aspect germane to a prior art rejection, but narrower in another aspect completely unrelated to the rejection, the recapture rule bars the claim;

(b) if the reissue claim is narrower in an aspect germane to [a] prior art rejection, and broader in an aspect unrelated to the rejection, the recapture rule does not bar the claim, but other rejections are possible.

(4)

*North American Container*

In *North American Container, Inc. v. Plastipak Packaging, Inc.*, 415 F.3d 1335, 75 USPQ2d 1545 (Fed. Cir. 2005), the Federal Circuit had occasion to further address *Substep (3)(a)* of *Clement*.

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*North American Container* involved a reissue patent, which had been held invalid by the U.S. District Court for the Northern District of Texas. The district court bottomed its invalidity holding based on a violation of the recapture rule. During prosecution of an application for patent, an examiner rejected the claims over a combination of two prior art references: Dechenne and Jakobsen. To overcome the rejection, *North American Container* limited its application claims by specifying that a shape of “inner walls” of a base of a container was “generally convex.” *North American Container* convinced the examiner that the shape of the base, as amended, defined over “both the Dechenne patent, wherein the corresponding wall portions 3 are *slightly concave* ... and the Jakobsen patent, wherein the entire reentrant portion is clearly *concave in its entirety*.” 415 F.3d at 1340, 75 USPQ2d at 1549. After a patent issued containing the amended claims, *North American Container* filed a reissue application seeking reissue claims in which (1) the language “inner wall portions are generally convex” was eliminated, but (2) the language “wherein the diameter of said re-entrant portion is in the range of 5% to 30% of the overall diameter of said side wall” was added. Thus, the claim sought be reissued was broader in some aspects and narrower in other aspects.



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The Federal Circuit, applying the *Clement* three-step test, held that the reissue claims were broader in scope than the originally-issued claims in that they no longer require the “inner walls” to be “generally convex.” The Federal Circuit further found that the broadened aspect (i.e., the broadened limitation) “relate[d] to subject matter that was surrendered during prosecution of the original-filed claims.” 415 F.3d at 1350, 75 USPQ2d at 1557. The Federal Circuit observed “the reissue claims were not narrowed with respect to the ‘inner wall’ limitation, thus avoiding the recapture rule.” The Federal Circuit stated:

[t]hat the reissue claims, looked at as a whole, may be of “intermediate scope” is irrelevant. . . . [T]he recapture rule is applied on a limitation-by-limitation basis, and ... [North American Container’s] deletion of the “generally convex” limitation clearly broadened the “inner wall” limitation.

*Id.* Thus, the Federal Circuit in *North American Container* further refined Substep (3)(a) of *Clement*: “broader in an aspect germane to a prior art rejection” means broader with respect to a *specific* limitation (1) added to overcome prior art in prosecution of the application which matured into the patent sought to be reissued and (2) eliminated in the reissue application claims.

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(5)  
*Ex parte Eggert*

The opinion in *Ex parte Eggert*, 67 USPQ2d 1716 (Bd. Pat. App. & Int. 2003), issued as a precedential opinion, is also part of the recapture precedent applicable to proceedings before the United States Patent & Trademark Office (USPTO). *Eggert* was entered on May 29, 2003, prior to the Federal Circuit's *North American Container* decision. In *Eggert*, a majority stated that “[i]n our view, the surrendered subject matter is the outer circle of Drawing 1 [the rejected claim prior to the amendment that resulted in the claim being issued] because it is the subject matter appellants conceded was unpatentable.” 67 USPQ2d at 1717. The majority further held that “in our view” subject matter narrower than the rejected claim but broader than the patented claim is not barred by the recapture rule. *Id.* The majority explained that if the finally rejected claim was ABC and the patent claim was ABCDEF, there would be recapture for ABC or anything broader than ABC, but not for claims directed to ABCX, ABCD<sub>Br</sub>, ABCEF, or A<sub>Br</sub>BCDEF, because those claims would be narrower than the finally rejected claim ABC. 67 USPQ2d at 1717. In its opinion, the majority recognized that the Federal Circuit had held that “the mere presence of narrowing limitations in the reissue claim is

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not necessarily sufficient to save the reissue claim from the recapture rule.” 67 USPQ at 1729.

Board of Patent Appeals and Interferences Standard Operating Procedure 2 (Revision 6) (August 10, 2005) mandates that a published precedential opinion of the Board is binding on all judges of the Board *unless* the views expressed in an opinion in support of the decision, among a number of things, are inconsistent with a decision of the Federal Circuit. In our view, the majority view in *Eggert* is believed to be inconsistent with the subsequent Federal Circuit decision in *North American Container* with respect to the principles governing application of Substep (3)(a) of *Clement*.

The *Eggert* majority’s analysis is believed to be consistent with *North American Container* in that the majority applied the three-step framework analysis set forth in applicable Federal Circuit opinions, *e.g.*, (1) *Pannu v. Storz Instruments Inc.*, 258 F.3d 1366, 1370-71, 59 USPQ2d 1597, 1600 (Fed. Cir. 2001); (2) *Clement*, 131 F.3d at 1470, 45 USPQ2d at 1165 and (3) *Hester*, 142 F.3d at 148, 46 USPQ2d at 1648-49. However, the *Eggert* majority also held that the surrendered subject matter was the rejected claim only rather than the amended portion of the issued claim. 67 USPQ2d at 1717. At a similar point in the

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recapture analysis, *North American Container* has clarified the application of the three-step framework analysis. *North American Container* holds that the “inner walls” limitation (a portion of the issued claim that was added to the rejected claim by amendment) was “subject matter that was surrendered during prosecution of the original-filed claims.” 415 F.3d at 1350, 75 USPQ2d at 1557.

It is believed that the Substep (3)(a) rationale of the *Eggert* majority (1) is not consistent with the rationale of the Federal Circuit in *North American Container* and (2) should no longer be followed or be applicable to proceedings before the USPTO.

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(6)

*What subject matter is surrendered?*

In a case involving Substep (3)(a) of Step 3 of *Clement*, what is the subject matter surrendered?

Is it

- (1) the subject matter of an application claim which was amended or canceled or
- (2) the subject matter of an application claim which was amended or canceled *and*, on a limitation-by-limitation basis, the territory falling between the scope of
  - (a) the application claim which was canceled or amended and
  - (b) the patent claim which was ultimately issued?

We believe *North American Container* stands for the proposition that it is (2) and not (1). Accordingly, we hold that it is (2).

(7)

*Clement principles are not per se rules*

Our reading of our appellate reviewing court's recapture opinions, as a whole, suggests that the *Clement* steps should not be viewed as per se rules. For example, we note the following in *Clement*, 131 F.3d at 1469, 45 USPQ2d at 1164:

Although the recapture rule does not apply in the absence of evidence that the applicant's amendment was "an admission that the scope of that claim was not in fact patentable," *Seattle Box Co. v. Industrial Crating & Packing, Inc.*, 731 F.2d 818, 826, 221 USPQ 568, 574 (Fed. Cir. 1984), "the court may draw inferences from changes in claim scope when other reliable evidence of the patentee's intent is not available," *Ball [Corp. v. United States]*, 729 F.2d at 1436, 221 USPQ at 294. Deliberately canceling or amending a claim in an effort to overcome a reference strongly suggests that the applicant admits that the scope of the claim before the cancellation or amendment is unpatentable, but it is not dispositive because other evidence in the prosecution history may indicate the contrary. *See Mentor [Corp. v. Coloplast, Inc.]*, 998 F.2d at 995-96, 27 USPQ2d at 1524-25; *Ball*, 729 F.2d at 1438, 221 USPQ at 296; *Seattle Box Co.*, 731 F.2d at 826, 221 USPQ at 574 (declining to apply the recapture rule in the absence of evidence that the applicant's "amendment ... was in any sense an admission that the scope of [the] claim was not patentable"); *Haliczer [v. United States]*, 356 F.2d at 545, 148 USPQ at 569 (acquiescence in the rejection and acceptance of a patent whose claims include the limitation added by the applicant to distinguish the claims from the prior art shows intentional withdrawal of subject matter); *In re Willingham*, 282 F.2d 353, 354, 357, 127 USPQ 211, 213, 215 (CCPA 1960) (no intent to surrender where the applicant canceled and replaced a claim without an intervening action by the examiner). Amending a claim "by the inclusion of an additional limitation [has] exactly the same effect as if the claim as originally presented had been

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canceled and replaced by a new claim including that limitation.” *In re Byers*, 230 F.2d 451, 455, 109 USPQ 53, 55 (CCPA 1956). [Footnote and citations to the CCPA reports omitted.]

(8)

*Allocation of burden of proof*

What is the proper allocation of the burden of proof in ex parte examination?

For reasons that follow, we hold that an examiner has the burden of making out a prima facie case of recapture. The examiner can make out a prima facie case of recapture by establishing that the claims sought to be reissued fall within Substeps (1) or 3(a) of Step 3 of *Clement*.

For reasons that follow, we also hold that once a prima facie case of recapture is established, the burden of persuasion then shifts to the applicant to establish that the *prosecution history* of the application, which matured into the patent sought to be reissued, establishes that a surrender of subject matter did not occur (or that the reissue claims are materially narrowed).

As will become apparent, our rationale parallels the practice in determining whether subject matter is surrendered when a doctrine of equivalents analysis occurs in infringement cases.

(9)

*Burden of proof analysis*

Our analysis begins with an observation made by our appellate reviewing court in *Hester*, 142 F.3d at 1481-82, 46 USPQ2d at 1649:

[A]s recognized in *Ball*, the recapture rule is based on principles of equity<sup>7</sup> and therefore embodies the notion of estoppel. 729 F.2d at 1439, 221 USPQ at 296. Indeed, the recapture rule is quite similar to prosecution history estoppel, which prevents the application of the doctrine of equivalents in a manner contrary to the patent's prosecution history. See *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, [520 U.S. 17, 33,] 117 S. Ct. 1040, 1051[, 41 USPQ2d 1865, 1873] (1997). Like the recapture rule, prosecution history estoppel prevents a patentee from regaining subject matter surrendered during prosecution in support of patentability. See *id.*

*Hester* argues that an analogy cannot be made with prosecution history estoppel because the reissue procedure and prosecution history estoppel are the antithesis of one another--reissue allows an expansion of patent rights whereas prosecution history estoppel is limiting. However, *Hester's* argument is unpersuasive. The analogy is not to the broadening aspect of reissue. Rather, the analogy is with the recapture rule, which restricts the permissible range of expansion through reissue just as prosecution history estoppel restricts the permissible range of equivalents under the doctrine of equivalents.

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<sup>7</sup> The reissue statute has been characterized as being remedial in nature, based on fundamental principles of equity and fairness and should be construed liberally. *In re Bennett*, 766 F.2d 524, 528, 226 USPQ 413, 416 (Fed. Cir. 1985) (in banc); *In re Willingham*, 282 F.2d 353, 354-55, 127 USPQ 211, 214 (CCPA 1960). Nevertheless, fairness to the public must also be considered. As stated in *Mentor*, "the reissue statement cannot be construed in such a way that competitors, properly relying on prosecution history, become patent infringers when they do so." 998 F.2d at 996, 27 USPQ2d at 1525.



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This court earlier concluded that prosecution history estoppel can arise by way of unmistakable assertions made to the Patent Office in support of patentability, just as it can arise by way of amendments to avoid prior art. *See, e.g., Texas Instruments, Inc. v. International Trade Comm'n*, 988 F.2d 1165, 1174, 26 USPQ2d 1018, 1025 (Fed. Cir. 1993).

*See also* Judge Michel's opinion concurring-in-part and dissenting-in-part in *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 234 F.3d 558, 602, 56 USPQ2d 1865, 1899 (Fed. Cir. 2000) (Festo I), *vacated and remanded*, 535 U.S. 722, 122 S. Ct. 1831, 62 USPQ2d 1705 (2002) (Festo II)<sup>8</sup> (Michel, J.):

[T]he law of prosecution history estoppel has developed with equal applicability to reissue patents and original patents whose claims were amended during prosecution. By at least 1879, the Supreme Court recognized that the process of obtaining a reissue patent precluded the patentee from recapturing that which he had disclaimed (i.e., surrendered), through the reissuance process.

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<sup>8</sup> The "Festo" convention used in this opinion is:

Festo I is the original in banc decision of the Federal Circuit.

Festo II is the decision of the Supreme Court.

Festo III is the decision of the Federal Circuit on remand.

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(10)

*Relevance of prosecution history*

“Surrendered subject matter” is defined in connection with prosecution history estoppel in *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 535 U.S. 722, 733-34, 122 S. Ct. 1831, 1838, 62 USPQ2d 1705, 1710-11 (2002) (Festo II):

The doctrine of equivalents allows the patentee to claim those insubstantial alterations that were not captured in drafting the original patent claim but which could be created through trivial changes. When, however, the patentee originally claimed the subject matter alleged to infringe but then narrowed the claim in response to a rejection, he may not argue that the surrendered territory comprised unforeseen subject matter that should be deemed equivalent to the literal claims of the issued patent. On the contrary, “[b]y the amendment [the patentee] recognized and emphasized the difference between the two phrases[,] ... and [t]he difference which [the patentee] thus disclaimed must be regarded as material.” *Exhibit Supply Co. v. Ace Patents Corp.*, 315 U.S. 126, 136-37, 62 S. Ct. 513, 518-19 [52 USPQ 275, 279-80] (1942).

Festo II goes on to comment, 535 U.S. at 737-41, 122 S. Ct. at 1840-42, 62 USPQ2d at 1712-14:

[Prosecution history estoppel’s] reach requires an examination of the subject matter surrendered by the narrowing amendment. [A] complete bar [would avoid] this inquiry by establishing a per se rule; but that approach is inconsistent with the purpose of applying the estoppel in the first place—to hold the inventor to the representations

made during the application process and to the inferences that *may reasonably* be drawn from the amendment (emphasis added).

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A patentee's decision to narrow his claims through amendment *may be presumed to be a general disclaimer of the territory between the original claim and the amended claim. Exhibit Supply*, 315 U.S., at 136-137, 62 S. Ct. 513 ("By the amendment [the patentee] recognized and emphasized the difference between the two phrases and proclaimed his abandonment of all that is embraced in that difference"). There are some cases, however, where the amendment *cannot reasonably be viewed as surrendering* a particular equivalent. The equivalent may have been unforeseeable at the time of the application; the rationale underlying the amendment may bear no more than a tangential relation to the equivalent in question; or there may be some other reason suggesting that the patentee could not reasonably be expected to have described the insubstantial substitute in question. In those cases *the patentee can overcome the presumption* that prosecution history estoppel bars a finding of equivalence (emphasis added).

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When the patentee has chosen to narrow a claim, *courts may presume* the amended text was composed with awareness of this rule and that the territory surrendered is not an equivalent of the territory claimed. In those instances, however, *the patentee still might rebut the presumption* that estoppel bars a claim of equivalence. The patentee must show that at the time of the amendment one skilled in the art *could not reasonably* be expected to have drafted a claim that would have literally encompassed the alleged equivalent (emphasis added).

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The same policy considerations that prevent a patentee from urging equivalents within what the Supreme Court refers to as “surrendered territory” should prima facie prohibit the patentee from being able to claim subject matter within the surrendered territory in reissue. Accordingly, the “surrendered subject matter” that may not be recaptured through reissue should be *presumed* to include subject matter broader than the patent claims in a manner directly related to (1) limitations added to the claims by amendment (either by amending an existing claim or canceling a claim and replacing it with a new claim with that limitation) to overcome a patentability rejection and (2) limitations argued to overcome a patentability rejection without amendment of a claim. These presumptions are believed to place practical and workable burdens on examiners and applicants.

(11)

*Admissible evidence in rebuttal showing*

As in the case of surrender when applying the doctrine of equivalents, a reissue applicant should have an opportunity to rebut any prima facie case made by an examiner.

What evidence may an applicant rely on to rebut any prima facie case of recapture?

We hold that the admissible rebuttal evidence generally should be limited to (1) the prosecution history of the application which matured into the patent sought to be reissued and (2) showings related to what was known by a person having ordinary skill in the art at the time an amendment was made. Nevertheless, we will not attempt to divine, at this time, all evidence that might be relevant. As with other issues that come before the USPTO, such as obviousness and enablement, the evidence to be presented will vary on a case-by-case basis, as will the analysis of that evidence.

“It is clear that in determining whether ‘surrender’ of subject matter has occurred, the proper inquiry is whether an objective observer viewing the prosecution history would conclude that the purpose of the patentee's amendment or argument was to overcome prior art and secure the patent.” *Kim v. Conagra Foods, Inc.*, 465 F.3d 1312, 1323, 80 USPQ2d 1495, 1502 (Fed. Cir. 2006). Thus, we also hold that an applicant must show that at the time the amendment was made, an “objective observer” could not reasonably have viewed the subject matter broader than any narrowing amendment as having been surrendered (or that an “objective observer” would view the reissue claims as materially narrowed). The showing required to be made by applicant is consistent with the public notice

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function of claims. Nevertheless, some limited extrinsic evidence may be relevant. However, extrinsic evidence unavailable to an “objective observer” at the time of the amendment is not relevant to showing that an “objective observer” could not reasonably have viewed the subject matter as having been surrendered. Limiting the nature of the admissible evidence is believed to be consistent with the Federal Circuit’s decision on remand following Festo II. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 344 F.3d 1359, 1367, 68 USPQ2d 1321, 1326 (Fed. Cir. 2003), *cert. denied*, 541 U.S. 988 (2004) (Festo III).

On remand, the Federal Circuit notes (*Id.* at 1367-70, 68 USPQ2d at 1326-29):

[W]e reinstate our earlier holding that a patentee’s rebuttal of the *Warner-Jenkinson* presumption is restricted to the evidence in the prosecution history record. *Festo* [I], 234 F.3d at 586 & n.6; *see also Pioneer Magnetics*, 330 F.3d at 1356 (stating that only the prosecution history record may be considered in determining whether a patentee has overcome the *Warner-Jenkinson* presumption, so as not to undermine the public notice function served by that record). If the patentee successfully establishes that the amendment was not for a reason of patentability, then prosecution history estoppel does not apply.

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... By its very nature, objective unforeseeability depends on underlying factual issues relating to, for example, the state of the art and the understanding of a hypothetical person of ordinary skill in the

art at the time of the amendment. Therefore, in determining whether an alleged equivalent would have been unforeseeable, a district court may hear expert testimony and consider other extrinsic evidence relating to the relevant factual inquiries.

. . . As we have held in the *Warner-Jenkinson* context, that reason should be discernible from the prosecution history record, if the public notice function of a patent and its prosecution history is to have significance. *See id.* at 1356 (“Only the public record of the patent prosecution, the prosecution history, can be a basis for [the reason for the amendment to the claim]. Otherwise, the public notice function of the patent record would be undermined.”); *Festo [I]*, 234 F.3d at 586 (“In order to give due deference to public notice considerations under the *Warner-Jenkinson* framework, a patent holder seeking to establish the reason for an amendment must base his arguments solely upon the public record of the patent’s prosecution, i.e., the patent’s prosecution history. To hold otherwise--that is, to allow a patent holder to rely on evidence not in the public record to establish a reason for an amendment--would undermine the public notice function of the patent record.”). Moreover, whether an amendment was merely tangential to an alleged equivalent necessarily requires focus on the context in which the amendment was made; hence the resort to the prosecution history. Thus, whether the patentee has established a merely tangential reason for a narrowing amendment is for the court to determine from the prosecution history record without the introduction of additional evidence, except, when necessary, testimony from those skilled in the art as to the interpretation of that record.

. . . When at all possible, determination of the third rebuttal criterion should also be limited to the prosecution history record. . . . We need not decide now what evidence outside the prosecution history record, if any, should be considered in determining if a patentee has met its burden under this third rebuttal criterion.

We interpret Festo III to generally, perhaps effectively, limit the admissible rebuttal evidence to the prosecution history record and extrinsic evidence related to the knowledge of the hypothetical person of ordinary skill in the art at the time of the amendment. Admitting evidence not available to the public, such as an affidavit of an attorney giving mental impressions from the attorney who made the amendment, would undermine the public notice function of the patent and its prosecution history.

(12)  
*Non-relevance of “intervening rights”*

We have not overlooked a possibility that an argument might be made that the so-called intervening rights provision relating to reissues makes jurisprudence on the doctrine of equivalents presumption inapplicable to reissue recapture rules. Our answer as to the argument is similar to the answer given by the Federal Circuit in *Hester* with respect to whether the doctrine of equivalents surrender principles have any applicability to reissue surrender principles. *Hester* squarely held that they do. Moreover, mixing “intervening rights” with “surrender” is like mixing apples with oranges or putting the cart before the horse. A patentee seeking a



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reissue claim which is barred by recapture is not entitled to a reissue patent under 35 U.S.C. § 251. If there is no reissue patent, there can be no intervening rights.

(13)

*Public Notice*

We believe that any recapture analysis must be bottomed principally on a “public notice” analysis which can occur only after a record becomes “fixed.” In the case of a patent, the “claims” and the “prosecution history” become fixed at the time the patent is issued--not during “fluid” patent prosecution where claims and arguments can change depending on the circumstances, *e.g.*, prior art applied and amendments to claims. It is from a fixed perspective that the public (not the patentee) must make an analysis of what the patentee surrendered during prosecution. Moreover, an applicant (not the public) controls what amendments and arguments are presented during prosecution. When an amendment or argument is presented, it is the applicant that should be in the best position to analyze what subject matter (*i.e.*, territory to use the Supreme Court’s language) is being surrendered (or explain why the reissue claims are materially narrowed).

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Our belief is supported by what appears to be dicta in *MBO Laboratories, Inc. v. Becton, Dickinson & Company*, No. 2006-1062, slip. op. at 12-13 (Fed. Cir. Jan. 24, 2007):

The recapture rule is a limitation on the ability of patentees to broaden their patents after issuance. . . . . Section 251 is “remedial in nature, based on fundamental principles of equity and fairness, and should be construed liberally.” However, the remedial function of the statute is limited. Material which has been surrendered in order to obtain issuance cannot be reclaimed via Section 251: . . . It is critical to avoid allowing surrendered matter to creep back into the issued patent, since competitors and the public are on notice of the surrender and may have come to rely on the consequent limitations on claim scope. . . . (“[T]he recapture rule ... ensur[es] the ability of the public to rely on a patent’s public record.”). The public’s reliance interest provides a justification for the recapture rule that is independent of the likelihood that the surrendered territory was already covered by prior art or otherwise unpatentable. The recapture rule thus serves the same policy as does the doctrine of prosecution history estoppel: both operate, albeit in different ways, to prevent a patentee from encroaching back into territory that had previously been committed to the public. (citations omitted.)

*B. The Prima Facie Case*

(1)

*Examiner's First Theory of the Rejection*

Our Findings of Fact 81-85 set out the basis upon which the Examiner originally made a recapture rejection in the Final Office Action. As noted in Finding of Fact 86, the record supports the Examiner's findings.

Basically, in the application which matured into the patent now sought to be reissued, the Examiner rejected originally filed independent claims 1 and 7 over the prior art. Applicants proceeded to re-write application claim 1 by adding limitations. Amended application claim 1 issued as patent claim 1. Applicants also proceeded to re-write application claim 7 by adding limitations. Amended application claim 7 issued as patent claim 7.

The Examiner made six points in Findings of Fact 83 and 84:

(1) reissue claims 21-23 and 34 are broader than the original patent claims

by the following two limitations: (1) the requirement that the material of the chip carrier is a "glass filled epoxy" has not been included in these claims; and (2) the requirement of "said chip carrier having a

coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/C°” has been completely left out of these claims;

- (2) reissue claims 24 and 25 are broader than the original patent claims in that the coefficient of thermal expansion of the chip carrier (i.e., “at least  $17 \times 10^{-6}$  ppm/C°”) has been completely left out of these claims;
- (3) the broader aspects of the reissue claims relate to surrendered subject matter because “claims 1 and 7, as originally filed in patent Application '467 [and cancelled during prosecution], correspond to claims 21 and 34, respectively, of the instant Reissue Application except that Reissue claims 21 and 34 now each include the limitation ‘an encapsulation material encapsulating said first set of solder connections’”;
- (4) “this [encapsulation material] limitation was not considered to be germane to the prior art rejection given in Application '467” as “[t]his feature was taught by several references cited by [the Examiner] during prosecution of Application '467”;
- (5) “Applicants repeatedly distinguished the amended (patented) claims of Application '467 over the prior art by arguing that the prior art fails to

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teach or suggest a chip carrier made of glass filled epoxy FR-4 material which has a thermal coefficient of expansion of at least  $17 \times 10^{-6} / ^\circ\text{C}$ "; and

(6) "the Board of Patent Appeals and Interferences ("Board") were persuaded by the patentees' above-mentioned arguments and accordingly reversed the obviousness rejection made by [the Examiner] based on the above arguments by the patentees."

The Examiner's accurate factual analysis demonstrates that the Examiner has made out a prima facie case of recapture consistent with the test set forth in *Clement*.

(2)  
*Second Examiner's Theory of the Rejection*

Our Findings of Fact 89-93 set out the basis upon which the Examiner made a recapture rejection in the Examiner's Answer. As noted in Finding of Fact 93, the record supports the Examiner's findings.

Basically, in the application which matured into the patent now sought to be reissued, the Examiner rejected originally filed independent claims 1 and 7 over the prior art. Applicants proceeded to re-write application claim 1 by adding

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limitations. Amended application claim 1 issued as patent claim 1. Applicants also proceeded to re-write application claim 7 by adding limitations. Amended application claim 7 issued as patent claim 7.

The Examiner made three points in Findings of Fact 90-92:

- (1) “the reissue claims 21-25 and 34 are broader than the patented Claims 1-12 of Application '467 in two aspects that are germane to the prior art rejection” because “reissue Claims 21 and 34 are recitations of patented Claims 1 and 7 of Application '467 minus the limitations of the ‘glass filled epoxy’ carder material and the requirement that the carrier have a CTE of ‘at least  $17 \times 10^{-6}$  ppm/°C””;
- (2) the broader aspects of the reissue claims relate to surrendered subject matter because these “aspects that were vigorously argued by the Appellants, with agreement by the Board, as patentable over the prior art of record in Application '467”; and
- (3) these broader aspects are “therefore germane to the prior art rejection”;

As we discussed in Section III. A. (8), we hold that the Examiner can make out a prima facie case of recapture by establishing that the claims sought to be reissued fall within Substeps (1) or 3(a) of *Clement*. The Examiner's accurate

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factual analysis demonstrates that the Examiner also has made out a prima facie case of recapture. Further, we hold that with respect to the Examiner's theory of the rejection, the burden of persuasion now shifts to the applicant to establish that the *prosecution history* of the application, which matured into the patent sought to be reissued, establishes that a surrender of subject matter did not occur or that the reissued claims were materially narrowed.

*C. Appellants' Response*

(1)

*To the Examiner's First Theory of the Rejection*

Applicants argue at pages 4-6 of the Appeal Brief filed August 16, 2000 that:

First, and of absolute importance, is that each of the claims now in the reissue application is of a scope that was not considered during the prosecution of the application leading up to the subject patent.

We believe the argument misses the point. The appropriate three-step process for applying the recapture rule was articulated in *Pannu*, 258 F.3d 1366, 59 USPQ2d 1597 (Fed. Cir. 2001):

The first step is to "determine whether and in what 'aspect' the reissue claims are broader than the patent claims." "The second step is to

determine whether the broader aspects of the reissued claim related to surrendered subject matter.” Finally, the court must determine whether the reissued claims were materially narrowed in other respects to avoid the recapture rule.

*Id.* at 1371, 59 USPQ2d at 1600 (internal citations omitted). The *Pannu* test does not include a determination of whether or not a claim of the same scope was considered during the original prosecution.

Rather, the significant issue before us is whether the limitation of “an encapsulation material encapsulating said first set of solder connections” (reissue claim 21), or “encapsulating said first set of solder connections” (reissue claim 34), “materially narrows” the reissue claim so as to avoid recapture of originally filed claims 1 and 7. Appellants do not dispute that originally filed claims 1 and 7 were surrendered by cancellation during prosecution of the patent application. Appellants do not argue in the brief that the “encapsulating” limitation materially narrows the reissue claims.

Appellants also argue at page 5 of the Brief that “one must look to the claim as a whole to see what has been given up.” We agree. However, based on this argument, Appellants fail to set forth any reason that establishes that the Examiner erred with respect to the rejection.



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At pages 6-9 of the brief, Appellants provide a review of *Ball*, 729 F.2d 1429, 221 USPQ 289. Appellants then conclude without explanation at page 9 of the brief “just as the *Ball* case, in the instant case the broadening aspect is not material to the error alleged.” Appellants again fail to set forth any reason that establishes the Examiner erred with respect to the rejection.

We conclude that the Examiner has shown that the reissue claims are broader than the patent claims, has shown that the broader aspects of the reissued claim relate to surrendered subject matter, and has shown that the reissue claims are *not* materially narrowed in other respects to avoid the recapture rule. *Pannu*, 258 F.3d at 1371, 59 USPQ2d at 1600 (Fed. Cir. 2001).

(2)

*To the Examiner’s Second Theory of the Rejection*

Appellants argue at page 2 of the Reply Brief filed November 20, 2000, that:

It is submitted that the Examiner is presenting the issue as if the recapture doctrine relates solely to whether the claims are broader in some aspects than the issued claims and totally ignores whether the [reissue] claims are narrower in scope than the originally filed claims. Thus, the examiner is presenting a recapture argument based solely on the aspect of a broadening reissue when the claims are broader in some aspects and narrower in others than the issued claims allowed. However, this is not the proper test for recapture.

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We disagree. As we discussed above, we have already concluded that the Examiner has made out a prima facie case of recapture by establishing that the claims sought to be reissued fall within Substeps (1) or 3(a) of Step 3 of *Clement*. Step 1 of *Clement* explicitly determines whether and in what aspect any reissue claims are broader than the patent claims. This is exactly what the Examiner has done (Finding of Fact 91):

The sole issue upon which recapture depends in the instant Reissue Application is the broadening of the patented claims of Application '467 in aspects that were vigorously argued by the Appellants, with agreement by the Board, as patentable over the prior art of record in Application '467 and therefore germane to the prior art rejection[.]

Thus as we have also discussed above, we conclude the burden of persuasion has shifted to the applicant to establish that the *prosecution history* of the application, which matured into the patent sought to be reissued, establishes that a surrender of subject matter did not occur or that the reissue claims were materially narrowed.

At pages 3-4 of the Reply Brief, Appellants cite *Ball* and argue “[t]he proper focus is on the scope of the claims, not on the individual feature or element purportedly given up during prosecution of the original application.” We disagree. Appellants fail to address the later guidelines of *Clement* cited by the Examiner at

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page 10 of the Examiner's Answer entered October 19, 2000. The court in *Clement* focused on "aspects" of the claims. Therefore, we find no error in the Examiner's analysis based on individual elements surrendered during prosecution.

In the "Reply to Supplemental Examiner's Answer" ("Second Reply") filed February 18, 2005, Appellants present an *Eggert* based analysis and argue that in view of *Eggert* "it is clear that the recapture doctrine does not apply." As we discussed above, the majority view in *Eggert* is believed to be inconsistent with the subsequent binding Federal Circuit decision in *North American Container* with respect to the principles governing application the guidelines of *Clement*. Therefore, the overall result of Appellants' *Eggert* analysis fails to establish that the Examiner erred.

Within the *Eggert* analysis at page 5 of the second Reply Brief, Appellants present specific evidence. The ultimate point which we understand Appellants to be trying to make is that at the time of the amendment in the original patent application an objective observer would have viewed the "encapsulating" limitation as "germane to the prior art rejection" because it is intimately related to the composition (glass filled epoxy) and CTE (coefficient) limitations added by the

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amendment. Thus, Appellants argue the encapsulating limitation is a “material narrowing” of the reissue claims. We disagree.

Appellants present evidence that is not part of the prosecution history, and that is not a showing related to what was known by a person having ordinary skill in the art at the time an amendment was made. As discussed in Section III. A. (11) above, admitting evidence not available to the public would undermine the public notice function of the patent and its prosecution history. Specifically, Appellants offer a declaration statement from Mr. Gedney:

7. The invention disclosed and claimed in the '421 patent was conceived when he and the aforesaid Tamar A. Sholtes, his co-inventor, were members of a team at IBM's Endicott facility working on direct chip attachment. We realized that recent developments in encapsulation technology had made it possible to mount integrated circuit chips on chip carriers with higher coefficients of thermal expansion ("CTEs") than previously thought possible. These developments allowed us to consider building chip carriers out of organic dielectric materials such as glass-filled epoxies (commonly referred to as FR-4 materials) frequently used for printed circuit board or cardstock, or polyimides frequently used in tape automated bonding.

The “facts” recited in the declaration are not found in the prosecution history, and Appellants do not attempt to show that a person skilled in the art would have

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known these facts at the time the amendment was made. Therefore, we find this evidence is inadmissible to rebut the Examiner's prima facie case.

Furthermore, even if admissible, Appellant Gedney's declaration speaks of "recent developments" that occurred before the date of Appellants' invention and before the original patent application. Thus, the declaration supports recapture as Appellants knew these facts at the time the surrender generating amendment was made. That is, Appellants made the amendment and presented arguments while fully cognizant of these "facts." Therefore, the declaration supports the Examiner's rejection.

Additionally, the "recent developments in encapsulation technology" are not those of Appellants. This is confirmed in Appellants' Specification at column 8, lines 12-15, where the only disclosure of encapsulating is in reference to the Soga patent. As stated in the declaration, it is the "higher coefficients of thermal expansion" that Appellants recognized as being made possible. The declaration explicitly indicates this is Appellants' contribution to the art.

Appellants' arguments have not rebutted the presumption, upon which the Examiner's rejection is based, i.e., that at the time of the amendment an objective observer would reasonably have viewed the composition and CTE subject matter

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of the narrowing amendment as having been surrendered. Appellants have not shown that further limiting originally filed claims 1 and 7 (which were rejected based on Soga and Frankenly and cancelled by applicant) by including Soga's known encapsulating technique for its intended purpose to achieve an entirely expected result is a material narrowing of the reissue claims.

#### **IV. DECISION**

Upon consideration of the record, and for the reasons given, the decision rejecting claims 21-25 and 34 under 35 U.S.C. § 251 based on recapture is affirmed.<sup>9</sup>

#### **AFFIRMED**

**ARM**  
**FEM**  
**BRG**

**ELD**

---

<sup>9</sup> Appellants also submit that they are entitled to a decision by the Examiner as to whether the claims are obvious or not and, if not, the references cited and the way the references are applied (Br. 6 and Reply Br. 5). We do not review issues associated with the appropriateness of an Examiner's decision to *not* reject claims. Those issues are properly the subject of petition to The Director.

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DRIGGS, HOGG & FRY CO. L.P.A.  
38500 CHARDON ROAD  
DEPT. IEN  
WILLOUGHBY HILLS OH 44094

## **Appendix 1**

### *Drawings of application, as filed*

Brief description of the drawings of Gedney et al., U.S. Patent 5,483,421, of which the present applicant seek reissue (drawing sheets 1-3 are attached).

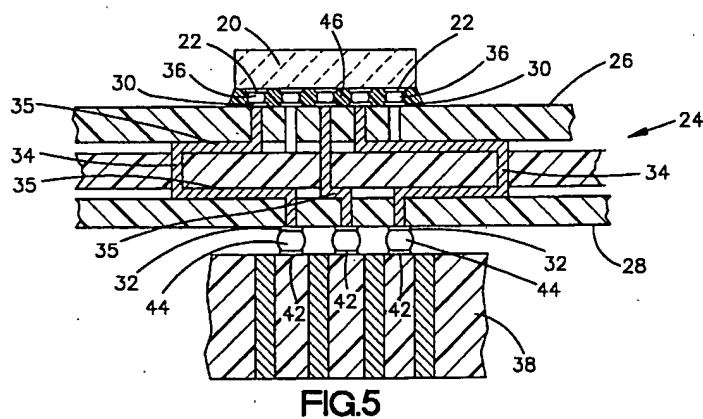
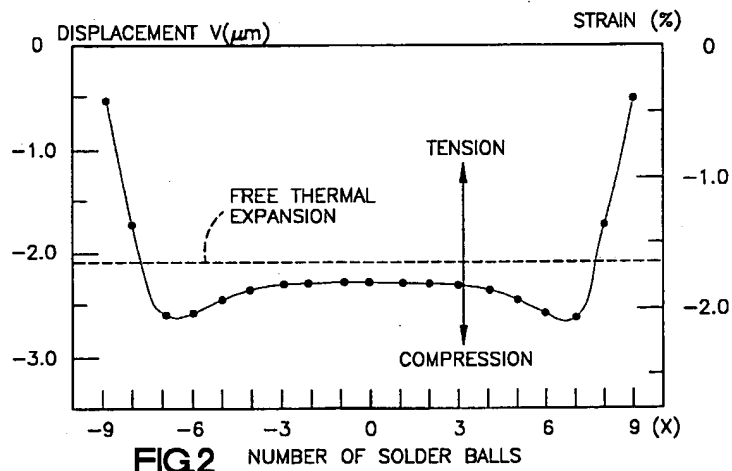
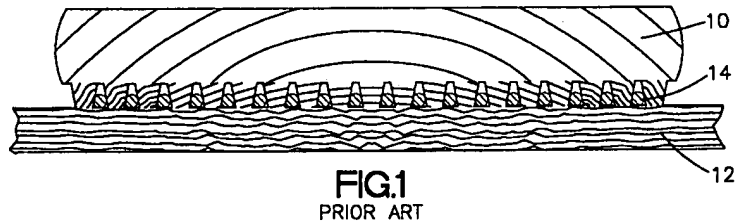
FIGURE 1 is a longitudinal section view, somewhat diagrammatic, showing the connection of a ceramic chip carrier to a glass filled organic circuit board card (FR-4) by means of solder ball connections, and depicting the stress pattern generated at elevated temperature due to thermal mismatch.

FIGURE 2 is a graph plotted to depict the relative deformation of a circuit board card and ceramic module under thermal stress showing the average normal strain in each solder ball connection.

FIGURE 3 is a graph showing the relative shear displacement between a circuit board and a ceramic module showing strain in the planar direction between the board and module and the average shear strain in each solder ball.

FIGURE 4 is an exploded perspective view showing the mounting of chips onto a carrier and carrier onto a circuit card according to the present invention.





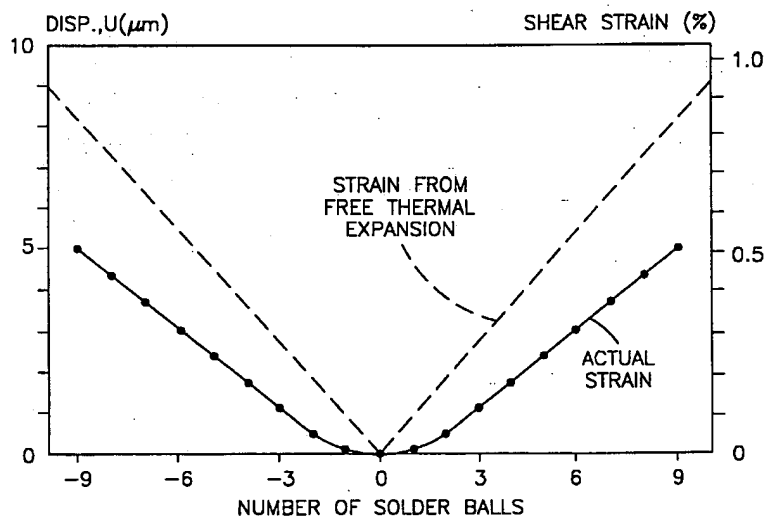


Fig.3  
PRIOR ART

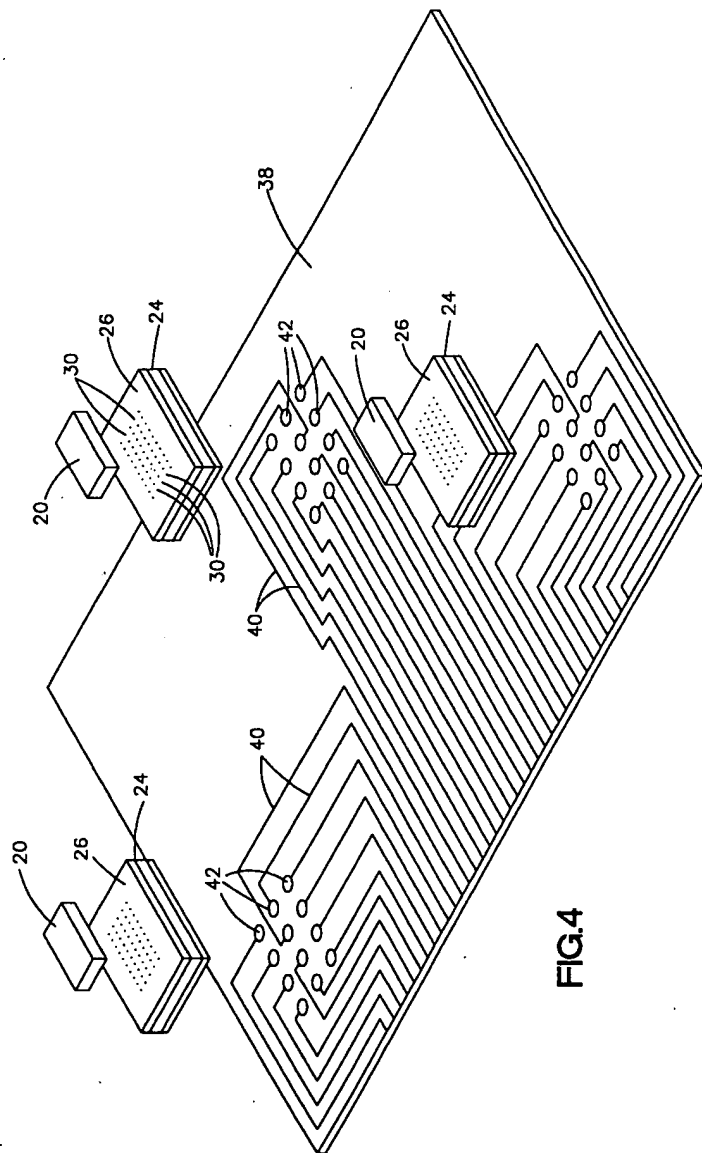


FIG. 4

## **Appendix 2**

### *Claims Of Original Patent Application 08/429,317, As Filed*

1. A package mounting integrated circuit chips onto a circuit board comprising:

an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

a chip carrier formed of an organic dielectric material having first and second opposite surfaces;

a first set of bonding pads formed on said first surface of the chip carrier and arranged in an array corresponding with the chip footprint;

a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

a first set of solder connections interconnecting the input/output pads on the chip to said first set of bonding pads on the chip carrier;

a second set of bonding pads formed on the second surface of the chip carrier arranged in an array;

electrically conducting vias extend through the chip carrier connecting said first set of bonding pads to the second set of bonding pads;

a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

a set of electrical connection sites formed on said circuit board and arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

a second set of solder connections interconnecting the pads of said second set of bonding pads on the chip carrier to the connection sites on the circuit board;  
and

wiring on said circuit board connected to said second set of bonding pads.

2. The package of claim 1 wherein said chip carrier and said circuit board are formed of the same material.

3. The package as defined in claim 2 wherein said material is a glass filled epoxy.

4. The package as defined in claim 1 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

5. The package as defined in claim 1 further characterized by the pattern of said first bonding pads being finer than the pattern of the second bonding pads.

6. The package as defined in claim 1 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

7. A method of mounting integrated circuit chips onto a circuit board comprising the steps of:

providing an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

providing a chip carrier formed of an organic dielectric material having first and second opposite surfaces;

forming a first set of bonding pads on said first surface of the chip carrier arranged in an array corresponding with the chip footprint;

providing a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

forming a first set of solder connections between the input/output pads on the chip and said first set of bonding pads on the chip carrier;

forming a second set of bonding pads on the second surface of the chip carrier arranged in an array;

forming electrically conducting vias through the chip carrier to connect said first set of bonding pads to the second set of bonding pads;

providing a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

forming a set of electrical connection sites on said circuit board arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

forming a second set of solder connections between the pads of said second set of bonding pads on the chip carrier and the connection sites on the circuit board; and

forming wiring on said circuit board connected to said second set of bonding pads.

8. The method of claim 7 wherein said chip carrier and said circuit board are formed of the same material.

9. The package as defined in claim 8 wherein said material is a glass filled epoxy.

10. The method as defined in claim 7 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

11. The method as defined in claim 7 further characterized by the pattern of said first bonding pads being finer than the pattern of the second bonding pads.

12. The method as defined in claim 7 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

### Appendix 3

*May 26, 1993 All Claims As Amended In Response  
To Non-Final Action In Original Patent Application*

(matter underlined added by the Amendment)  
(matter in [brackets] deleted by the Amendment)

1. A package mounting integrated circuit chips onto a circuit board comprising:

an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

a chip carrier formed of an organic glass filled epoxy dielectric material having first and second opposite surfaces;

said chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/c°;

a first set of bonding pads formed on said first surface of the chip carrier and arranged in an array corresponding with the chip footprint;

a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

a first set of solder connections interconnecting the input/output pads on the chip to said first set of bonding pads on the chip carrier;

an encapsulation material encapsulating said first set of solder connections;

a second set of bonding pads formed on the second surface of the chip carrier arranged in an array;

electrically conducting vias extend through the chip carrier connecting said first set of bonding pads to the second set of bonding pads;

a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

a set of electrical connection sites formed on said circuit board and arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

a second set of solder connections interconnecting the pads of said second set of bonding pads on the chip carrier to the connection sites on the circuit board; and

wiring on said circuit board connected to said second set of bonding pads.

2. The package of claim 1 wherein said chip carrier and said circuit board are formed of the same material.

3. (Cancelled)

4. The package as defined in claim 1 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

5. The package as defined in claim 1 further characterized by [the pattern of said] first bonding pads being more closely spaced to each other [finer] than [the pattern of the] said second bonding pads.

6. The package as defined in claim 1 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

7. A method of mounting integrated circuit chips onto a circuit board comprising the steps of:

providing an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

providing a chip carrier formed of an organic glass filled epoxy dielectric material having first and second opposite surfaces;

said chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/c°;

forming a first set of bonding pads on said first surface of the chip carrier arranged in an array corresponding with the chip footprint;



providing a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

forming a first set of solder connections between the input/output pads on the chip and said first set of bonding pads on the chip carrier;

an encapsulation material encapsulating said first set of solder connections;

forming a second set of bonding pads on the second surface of the chip carrier arranged in an array;

forming electrically conducting vias through the chip carrier to connect said first set of bonding pads to the second set of bonding pads;

providing a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

forming a set of electrical connection sites on said circuit board arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

forming a second set of solder connections between the pads of said second set of bonding pads on the chip carrier and the connection sites on the circuit board; and

forming wiring on said circuit board connected to said second set of bonding pads.

8. The method of claim 7 wherein said chip carrier and said circuit board are formed of the same material.

9. (Cancelled)

10. The method as defined in claim 7 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

11. The method as defined in claim 7 further characterized by first bonding pads being more closely spaced to each other than said second bonding pads.

12. The method as defined in claim 7 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

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13. (NEW) The package as defined in claim 1 wherein the thickness of the conductors on said chip carrier is thinner than the wires of the wiring on the circuit board.

14. (NEW) The package as defined in claim 7 wherein the thickness of the conductors on said chip carrier is thinner than the wires of the wiring on the circuit board.

#### **Appendix 4**

##### *CLAIMS OF U.S. PATENT 5,483,421, AS RENUMBERED AT ALLOWANCE*

1. A package mounting integrated circuit chips onto a circuit board comprising:
  - an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;
  - a chip carrier formed of an organic glass filled epoxy dielectric material having first and second opposite surfaces;
  - said chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/c°;
  - a first set of bonding pads formed on said first surface of the chip carrier and arranged in an array corresponding with the chip footprint;
  - a pattern of conductors on said chip carrier connected to accommodate said input/output pads;
  - a first set of solder connections interconnecting the input/output pads on the chip to said first set of bonding pads on the chip carrier;
  - an encapsulation material encapsulating said first set of solder connections;
  - a second set of bonding pads formed on the second surface of the chip carrier arranged in an array;
  - electrically conducting vias extend through the chip carrier connecting said first set of bonding pads to the second set of bonding pads;
  - a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;
  - a set of electrical connection sites formed on said circuit board and arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

a second set of solder connections interconnecting the pads of said second set of bonding pads on the chip carrier to the connection sites on the circuit board;  
and

wiring on said circuit board connected to said second set of bonding pads.

2. The package of claim 1 wherein said chip carrier and said circuit board are formed of the same material.

3. The package as defined in claim 1 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

4. The package as defined in claim 1 further characterized by first bonding pads being more closely spaced to each other than said second bonding pads.

5. The package as defined in claim 1 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

6. The package as defined in claim 1 wherein the thickness of the conductors on said chip carrier is thinner than the wires of the wiring on the circuit board.

7. A method of mounting integrated circuit chips onto a circuit board comprising the steps of:

providing an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

providing a chip carrier formed of an organic glass filled epoxy dielectric material having first and second opposite surfaces;

said chip carrier having a coefficient of thermal expansion of at least  $17 \times 10^{-6}$  ppm/c°;

forming a first set of bonding pads on said first surface of the chip carrier arranged in an array corresponding with the chip footprint;

providing a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

forming a first set of solder connections between the input/output pads on the chip and said first set of bonding pads on the chip carrier;

an encapsulation material encapsulating said first set of solder connections;  
forming a second set of bonding pads on the second surface of the chip carrier arranged in an array;  
forming electrically conducting vias through the chip carrier to connect said first set of bonding pads to the second set of bonding pads;  
providing a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;  
forming a set of electrical connection sites on said circuit board arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;  
forming a second set of solder connections between the pads of said second set of bonding pads on the chip carrier and the connection sites on the circuit board; and  
forming wiring on said circuit board connected to said second set of bonding pads.

8. The method of claim 7 wherein said chip carrier and said circuit board are formed of the same material.

9. The method as defined in claim 7 wherein said first set of solder connections is formed of a higher melting point solder than said second set of solder connections.

10. The method as defined in claim 7 further characterized by first bonding pads being more closely spaced to each other than said second bonding pads.

11. The method as defined in claim 7 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

12. The package as defined in claim 7 wherein the thickness of the conductors on said chip carrier is thinner than the wires of the wiring on the circuit board.

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**Appendix 5**  
*The Reissue Claims On Appeal*

Claims 1-12. (Unchanged from patent).

Claims 13-20. (Cancelled)

21. A package mounting integrated circuit chips onto a circuit board comprising:

an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

a chip carrier formed of an organic dielectric material having first and second opposite surfaces;

a first set of bonding pads formed on said first surface of the chip carrier and arranged in an array corresponding with the chip footprint;

a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

a first set of solder connections interconnecting the input/output pads on the chip to said first set of bonding pads on the chip carrier;

an encapsulation material encapsulating said first set of solder connections;

a second set of bonding pads formed on the second surface of the chip carrier arranged in an array;

electrically conducting vias extend through the chip carrier connecting said first set of bonding pads to the second set of bonding pads;

a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

a set of electrical connection sites formed on said circuit board and arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

a second set of solder connections interconnecting the pads of said second set of bonding pads on the chip carrier to the connection sites on the circuit board;  
and

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wiring on said circuit board connected to said second set of bonding pads.

22. A package according to claim 21 wherein the thermal coefficient of expansions of the material of the chip carrier and the material of the circuit board do not differ by more than about 20%.

23. The package of claim 21 wherein said chip carrier and said circuit board are formed of the same material.

24. A package according to claim 21 wherein said material is formed of a glass filled epoxy.

25. A package according to claim 21 wherein said material is a formed of a polyimide.

Claims 26-33. (Cancelled)

Claim 34. [see next page]

34. A method of mounting integrated circuit chips onto a circuit board comprising the steps of:

providing an integrated circuit chip having a surface array of input/output pads on one side thereof which array forms a footprint;

providing a chip carrier formed of an organic dielectric material having first and second opposite surfaces;

forming a first set of bonding pads on said first surface of the chip carrier arranged in an array corresponding with the chip footprint;

providing a pattern of conductors on said chip carrier connected to accommodate said input/output pads;

forming a first set of solder connections between the input/output pads on the chip and said first set of bonding pads on the chip carrier;

encapsulating said first set of solder connections;

forming a second set of bonding pads on the second surface of the chip carrier arranged in an array;

forming electrically conducting vias through the chip carrier to connect said first set of bonding pads to the second set of bonding pads;

providing a circuit board formed of an organic material having a coefficient of thermal expansion similar to the chip carrier;

forming a set of electrical connection sites on said circuit board arranged in a pattern corresponding to the pattern of the array of the second bonding pads on said chip carrier;

forming a second set of solder connections between the pads of said second set of bonding pads on the chip carrier and the connection sites on the circuit board; and

forming wiring on said circuit board connected to said second set of bonding pads.